He had found the same kind of ruins all over the country, very frequently on the summit of difficult kopjes. Those at Tati and Impakwe are good examples; but the most perfect, perhaps, of all lies north-west of Tati. The tower there is about sixty feet in length and breadth, and eighty feet high; the walls about fifteen feet thick; and it is entered by a passage winding spirally to the top, which is so arranged as to be commanded by archers from the interior all the way, and is so narrow that it admits of the passage of one person only at a time.

DEVELOPMENT OF MODERN MARINE ENGINEERING.[1]

THE development of modern marine engineering in the United States may fairly be said to have begun with the construction of the engines of the steamship "George W. Clyde," by William Cramp & Sons, in 1871, which were the pioneer two crank compound engines in America. Prior to this our engineers and machinists had brought the simple engine to its zenith of possible development, but with the advent of the compound engine that era ceased to be of interest except in the historical sense.

The discovery of the principle of expansion, and the theory of the compound engine based upon it, long antedate their practical application. The earliest works on steam engineering contain evidences of knowledge of the principle, and foreshadow the application of expansion; but the compound engine as a practical fact is only about twenty-four years old in England, and about twenty years old in the United States. Its success as a fuel economizer at once dominated the construction of simple engines, and all other American ship-builders were compelled to follow Cramp's lead.

From the "George W. Clyde," in 1871, to Mr. Jay Gould's celebrated steam-yacht "Atalanta," in 1882, a period of eleven years, the development of the compound engine was steadily pushed to its climax of air-tight fire-room, forced draught, and the highest boiler-pressure consistent with economy in double expansion. This limit was reached in the "Atalanta;" and during the intervening period Messrs. Cramp & Sons had built about 70,000 registered tons of iron steam shipping, besides a number of yachts and other small crafts.

The era of double expansion terminated in 1885, with the construction of the steam-yacht "Peerless," which was equipped with the first triple expansion engines built in the United States.

This remarkable little ship was built by Cramp & Sons on their own account, at a cost approximating $100,000, simply as a practical experiment in the direction of the advance from two to three expansions of working steam. The result of the experiment left no room for argument as to the efficacy of the new system; and, though a few merchant ships were afterwards built by them with ordinary compound engines, they were merely duplicates of earlier vessels, and none but triple expansion engines were ever afterward designed or recommended by that firm.

In the "Peerless," as an experimental ship, Messrs. Cramp & Sons went to what has since been recognized as the upper limit of economical boiler-pressure for the purposes of triple expansion, which was 155 pounds. The registered tonnage of the "Peerless" was 228 only, but her engines developed about 1,060 indicated horse-power, giving her a speed of 17¼ knots, which made her the fastest steam-yacht of her time and class.

From the "Peerless" in 1885 to the "Vesuvius" in 1889 was a period marked by tremendous progress. In the latter vessel a power of 4,440 horses was developed in 253 tons weight of machinery, and applied to the propulsion of about 905 tons of displacement, the result being a speed of 21.65 knots an hour.

During this period Messrs. Cramp & Sons also built the horizontal triple expansion engines of the "Newark," "Philadelphia," "Baltimore," and "Yorktown," United States men-of-war, together with about 56,000 horse-power of triple expansion machinery for merchant vessels, a compound oscillating engine for the Stonington Steamship Line steamer "Connecticut" (with cylinders 56 inches and 104 inches respectively, and 11 feet stroke), — the largest engine of that type ever built, and carrying 110 pounds of steam-pressure,— together with several heavy compound pumping-engines for water-works, ranging in capacity from 10,000,000 to 20,000,000 gallons per day.

[1] From The Crank.

Advantage was taken of this school of development by the Navy Department, and Chief Engineer George W. Melville was stationed at the ship-yard of Cramp & Sons as inspector of machinery. While serving as such, Mr. Melville designed the engines of the cruiser "San Francisco," and laid broad and deep the foundation of that knowledge of marine engineering which, since his promotion to the chiefship of the Bureau of Steam Engineering, has found expression in a group of machinery designs aggregating over 150,000 horse-power, all of which are now in various stages of construction, and classed by all competent critics at home and abroad as representing advanced types of marine engineering in every sense.

The latest of Messrs. Cramp & Sons' engines brought to trial are those of the United States cruiser "Newark," which are of the horizontal, direct-acting, three-cylinder type. They weigh, including water in the boilers, 761 tons, and developed, on four hours' trial, 8,660 indicated horse-power, or 11.64 horse-power to the ton of weight, which exceeds any other performance of that type of machinery.

At the present time this concern has in the course of construction the machinery for two 10,000-ton battle-ships, one armored cruiser of 3,100 tons, and one protected cruiser of 7,300 tons, embracing, in all, eleven engines of approximately 60,000 indicated horse-power, of which three are to be placed in the latter vessel to drive triple screws, and designed to produce a speed of 21 knots.

It is quite generally conceded that, in the production of these colossal machines, the limit of size and weight of boilers of the cylindrical or tubular type has been reached; those for the armored cruiser "New York" having a diameter of 15.9 feet, requiring a shell plate thickness of 1.32 inches, and weighing 70 tons each when ready for installation on board ship.

The machinery plans for the 8,200-ton armored cruiser, and the 7,300-ton protected cruiser, present several interesting novelties. The first named is to be powered with four engines, two working on each shaft, and provided with means of disconnection so as to cruise under half power under ordinary circumstances. These four engines are installed in separate water-tight compartments. The power is 4,500 each, or 18,000 collectively, and is expected to produce a speed of twenty knots.

In the 7,300-ton protected cruiser there are to be three engines, on three shafts. Two of the engines, driving the port and starboard shafts, are placed in the usual manner on twin screw vessels. The third, driving the central shaft, is placed abaft the other two, each having its own compartment.

These are to be among the most powerful machines ever built, having 7,000 indicated horse-power each, or 21,000 collectively, and are to produce a speed of twenty-one knots.

SUBMARINE GUNS.

C. S. BUSHNELL of New Haven, vice-president of the Ericsson Coast Defence Company, which has just had the old "Destroyer" taken out of the Brooklyn Navy Yard and hauled up on Simpson's dry dock at South Brooklyn for repairs, says, in the *New York Times*, in regard to the fitting-up of the vessel for the trial of a newly invented gun, —

"On the 'Destroyer' the late Capt. Ericsson and C. H. Delamater spent $150,000. The vessel is 120 feet long, and is substantially constructed, though now in great need of repairs. Our company has a capital of $250,000. We are fitting up the vessel for the purpose of testing a gun that will fire under water. Now, with the heavy nettings which the big war-vessels have for the protection of themselves against torpedoes, the ordinary projectiles are almost useless.

"But with the gun that is to be tested on the 'Destroyer' we can make a projectile penetrate any of the nettings that are now in use. We are to use a sixteen-inch gun. That which we will experiment with is being constructed at Bethlehem, Penn., and is about half done. It is to be 35 feet in length. The projectile is to be 25 feet long, and to throw it a charge of twenty-five

pounds of powder will be used. The shell will contain from 300 to 400 pounds of nitro-glycerine, enough to blow up any vessel afloat if struck right. The muzzle of the gun will protrude for ten feet under water, and the projectile will be carried from 750 to 1,000 feet. The projectile will extend eight feet beyond the muzzle of the gun before firing. We intend to try the gun for the first time at Newport next July, having obtained from Congress an appropriation for making the tests.

"With a few such vessels as the 'Destroyer' will be when equipped with our gun, the armed fleets of the world could be swept out of existence. I believe that this invention will revolutionize naval gunnery throughout the world. One of our shells can be sent right through the netting and into the side of a vessel, where a torpedo could not penetrate. Commodore Folger of the Ordnance Department has written a letter to me, saying that he has prepared a heavy steel netting for a target, upon which our gun can be tested. Later we shall buy an old hulk and blow it up with one of our percussion shells, to show the efficacy of the new gun.

"I think that if the test proves satisfactory the government will arm some of the naval vessels with it. For the price that one of our big new ships would cost we could build and arm five of the smaller ships, which would be able to sink the best navy afloat. If the nations should arm their navies with these guns, it would so enhance their destructive power that the powers would not dare to go to war with each other. Since ships have been armed with the Hotchkiss rapid-firing guns, there has not been a naval battle. In a sea fight these guns would cause terrible havoc. Vessels of the 'Destroyer' type are to be heavily armored, so that they can approach any vessel without being injured. These vessels will be only a foot out of the water, and that part will be armored, so very little will be exposed to an enemy's guns. One of these vessels, made to steam at great speed, can be made very effective."

Mr. Bushnell was associated with Ericsson in the construction of the "Monitor."

HEALTH MATTERS.

African Arrow Poison.

THE poisons used by the natives of Africa to render fatal the wounds made with their arrows, as described by Mr. Stanley in his recent work on Africa, are, when fresh, of most extraordinary power. Faintness, palpitation of the heart, nausea, pallor, and beads of perspiration break out over the body with extraordinary promptness, and death ensues. One man is said to have died within one minute from a mere pin-hole puncture in the right arm and right breast; another man died within an hour and a quarter after being shot; a woman died during the time that she was carried a distance of a hundred paces; others died in varying spaces of time up to a hundred hours. The activity of the poison seemed to depend on its freshness. The treatment adopted, as we learn from the *Medical and Surgical Reporter*, was to administer an emetic, to suck the wound, syringe it, and inject a strong solution of carbonate of ammonia. This carbonate-of-ammonia injection seems to have proved a wonderful antidote, if it could be administered promptly enough. One of the poisons with which the weapons are smeared is a dark substance like pitch. According to the native women, it is prepared from a local species of arum. Its smell when fresh recalls the old blister plaster. It is strong enough to kill elephants. This poison is not permitted to be prepared in the village. It is manufactured and smeared on the arrows in the bush. These results of the African arrow poison are quite remarkable; but it would be interesting to know if they owe any thing to fear and its effects, or if similar results can be obtained by inoculating the lower animals.

Inoculation of Dog Serum as a Remedy for Tuberculosis.

In a series of communications made in the course of the last two years to the Société de Biologie, MM. Héricourt and Richet have given the results obtained by the injection of the blood of an animal refractory to tuberculosis, such as the dog, into the economy of one susceptible to the onslaughts of the bacillus. They have demonstrated experimentally, according to the *Lancet*, that such a proceeding exerts a retarding influence on the evolution of tuberculosis artificially communicated, without, however, stopping it altogether. With a view of intensifying these partially protective properties of canine blood, they inoculated the dog with a large dose of very active tuberculous matter, and one month later (the animal having lost flesh, and exhibiting manifest signs of ill health) injected into the peritoneal cavity of three rabbits seventy cubic centimetres of the dog's blood. A week later these rabbits were, with three other test-rabbits, inoculated with strong tuberculous virus, with the result that in twenty-five days two of the latter had succumbed, the rest surviving. Their ultimate fate is not recorded. Encouraged by these results, MM. Héricourt and Richet have extended the application of their method to tuberculous human beings, employing the serum only, and selecting the interscapular region as the seat of inoculation. M. Richet reports (Société de Biologie, Jan. 24) that four phthisical men have, since the early part of December, 1890, been subjected to this novel treatment. The results obtained seem to warrant the assumption that the introduction of the serum of dog's blood into the human economy counteracts, to some extent at least, the noxious influence of Koch's bacillus.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Can One see the Blood-Corpuscles in his own Eyes?

TO some this may seem an idle question, — an absurdity; but when we remember that the sensitive layer of the retina is on the back side, and that there are blood-vessels in front of it, it may not seem so improbable. Nevertheless, the ease with which it may really be done is quite surprising.

If the eyes are turned toward a dimly lighted blank space, and adjusted to see distant objects, or as when we "gaze on vacancy," there will appear flitting across the illuminated area small bright spots. They will seem to flash into vision, pass over a few degrees, usually in a curved path, then suddenly disappear. The circumstances found favorable for observing this phenomenon are to look toward the sky or a snowy surface on a cloudy day, or on a brighter day with the eyes nearly closed. Seldom more than a dozen of these luminous points may be seen at once, and usually not more than two or three distinctly.

They may be easily distinguished from the tear-drops trickling over the front of the eye, which are often visible at nearly the same time, by their being of uniform size, and moving rapidly in different directions; while the tears are of variable size, like raindrops on a window-pane, and move slowly downward, or by the motion of the eyelids upward.

They are not to be confounded with *muscæ volitantes*, which are of variable shape, size, and color, and, besides, slow of motion, and not so quickly disappearing.

That these minute bodies are really red corpuscles floating through the retinal capillaries, is indicated by the following facts: —

1. They move in definite paths. Having noted one, another will be seen to pass exactly the same path in from half a second to two seconds.

2. They always move in the same direction in the same path, never back and forth.

3. They are of uniform size, and appear to be of a yellowish color.

4. By comparing them with objects of known size at known distances, they have been approximately estimated to correspond in size to red corpuscles. Accurate measurements seem impracticable from the nature of the case.

The reason that they are visible while the capillaries in which they float are not, is easily explained by the familiar principle that we become insensible to that which is constantly present, and are specially impressed by that which is transient or novel. The familiar experiment of Purkinje shows us that the capillaries may become visible when light comes from a novel direction, so